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Note that this section was developed for the allowable stress/load factor design manual and has not yet been updated for changes since late 2006 or for load and resistance factor design.

5.3 Haunches

5.3.1 General

For continuous welded plate girder (CWPG) and rolled steel beam (RSB) bridges, haunch design is directly related to lengths of shear studs that are welded to the top flanges of the girders or beams. When designing the haunches for steel bridges the designer should consult office policy for shear studs [BDM 5.5.1.4.1.8] in addition to the haunch policies in following articles.

5.3.1.1 Policy overview

For pretensioned prestressed concrete beam (PPCB), continuous welded plate girder (CWPG), and rolled steel beam (RSB) bridges the office typically uses a variable concrete haunch thickness at each beam or girder to fit the roadway surface to the top profiles of the beams or girders. The design haunch is used in determining the beam or girder seat elevations and the estimated deck concrete quantity.

The designer should set haunch thicknesses at least 0.5 inch (13 mm) inside the minimum and maximum design limits of -0.5 inch at edge of beam or girder and 3.5 inches at centerline of beam or girder, with consideration of shear steel, so that the contractor will have tolerances for both upward and downward adjustments in the field.

In the field the contractor will set the beams or girders on the bearings at the beam seats and will survey the tops of beams or girders at the intervals given on the “Haunch Data Detail” sheet ~~[OBS MM No. 62]~~ or, for RSB bridges, the “Beam Line Haunch Data” sheet [OBS 5261A, 5263A, etc.]. Then the contractor can subtract the survey elevations from the beam line haunch elevations given on the sheet to determine the haunch thicknesses for setting the deck forms.

If limits given on the plans for haunch are exceeded in the field, the Resident Construction Engineer may reset the profile grade to adjust to the differing as-built conditions. If the grade adjustment is not practical for a PPCB bridge, thick haunches may be reinforced with additional bars so that the beam stirrups are extended a minimum of 2.5 inches (65 mm) into the deck. If the grade adjustment is not practical for a CWPG or RSB bridge, the office will address the haunch problem on a case-by-case basis.

5.3.1.2 Design information

Reserved

5.3.1.3 Definitions

Reserved

5.3.1.4 Abbreviations and notation

CWPG, continuous welded plate girder
PPCB, pretensioned prestressed concrete beam
RSB, rolled steel beam

5.3.1.5 References

Reserved

5.3.2 PPCB bridges

5.3.2.1 Analysis and design

As with other beam or girder superstructure types the designer should stay at least 0.5 inch within the maximum haunch of 3.5 inches at centerline of beam and -0.5 inch at edge of beam. These limits will be given for the contractor in a note on the plans.

The maximum and minimum haunch limits may, however, be controlled by shear steel heights. The minimum shear steel clearance from top of deck is 2.5 inches, which may control minimum haunch, and the minimum shear steel embedment into the deck is 2.5 inches, which may control maximum haunch. For LXA through LXD (AM through DM) beams, standard shear reinforcement extends 4.5 inches (115 mm) above the top flange, and for BT, BTC, and BTD (BTM, BTCM, and BTDM) beams, shear reinforcement extends 5 inches (125 mm) above the top flange.

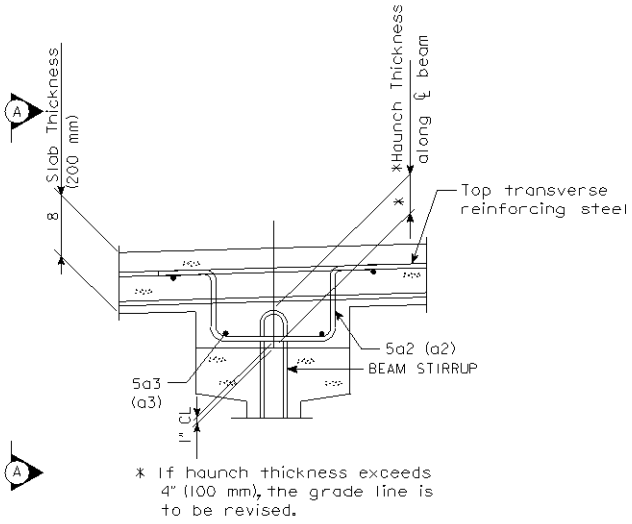
To start, set the minimum haunch at 0.5 inch at centerline of beam but not less than 0.0 inch at edge of top flange after cross slope is considered. During construction the contractor then will have 0.5 inch tolerance for minimum haunch.

Once the minimum is set, the haunch thickness can be checked along the entire beam line.

Check the minimum and maximum haunches based on shear steel heights. When checking the maximum haunch, the designer need not consider any cross slope or superelevation that increases the haunch at the edge of the deck. The maximum haunch should not exceed 3.0 inches so that the contractor has 0.5 inch tolerance for maximum haunch in the field. Modify the bridge seat elevations as necessary to attempt to fit within the haunch limits.

If the haunch at the beam centerline exceeds the maximum because of beam camber and grade considerations, the designer has the following two options. Option 1 is the preferred option when the maximum haunch is at midspan, and Option 2 is the preferred option when the maximum haunch is at the beam ends.

Option (1) Provide additional 5a2 and 5a3 (a2 and a3) bars with the deck reinforcing to adequately reinforce the haunch where it exceeds 2.0 inches (50 mm) as shown in Figure 5.3.2.1 ~~[OBS MM No. 26]~~.



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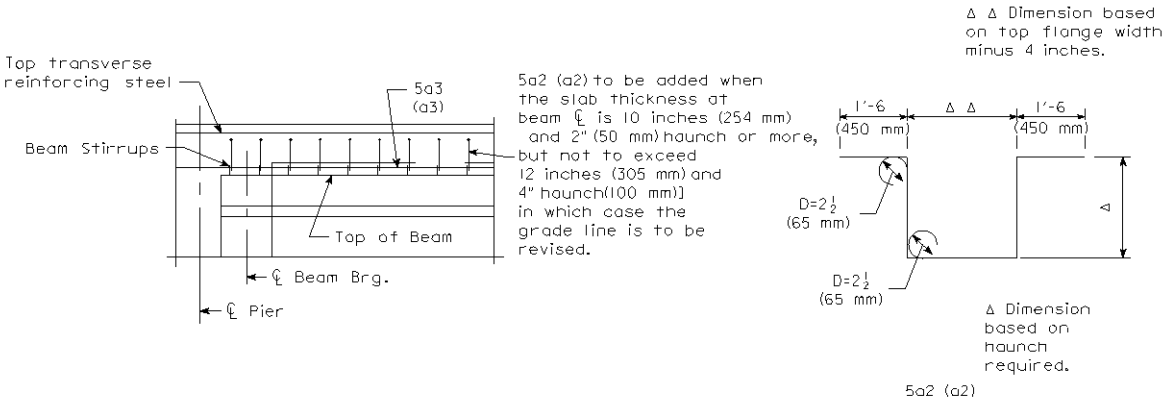


SECTION A-A

OPTION 1 DETAILS

PPCB Where haunch > 2" (50 mm)

Figure note:

- The 5a2 (a2) bars shall be epoxy coated.

Figure 5.3.2.1. Option 1 reinforcement for thick haunches on LXA-LXD (AM-DM) beams

Option (2) Adjust the length of the beam shear reinforcement in the required areas to extend a minimum of 2.5 inches (65 mm) into the bottom of the bridge deck. For this option, the office prefers that the beam shear reinforcement details be symmetrical. It is preferable to use 0.5-inch (13-mm) increments in the height adjustment rather than a uniform variation. The minimum design clearance above the top of the beam shear reinforcement shall be 3.5 inches (90 mm) inches, which will minimize interference of the shear reinforcement with the top layer of reinforcement in the deck.

If after the adjustments the haunch limits appear not to work for the project, the designer shall consult with the supervising Section Leader.

5.3.2.2 Detailing

The designer should provide the following information and haunch details for interior beams on the plans [OBS SS 4500-4513, 4542-4548 (M4500-M4513, M4542-M4548)]:

- "Beam Camber Data",
- "Slab Thickness at Beams (T)", and
- "Slab Thickness Details".

In addition, the designer shall provide a plan sheet titled "Haunch Data Detail" ~~[OBS MM No. 62]~~. The purpose of the sheet is to provide beam line haunch elevations convenient for the contractor to use in setting field haunch. The designer determines the elevations by taking each beam line slab elevation, subtracting the deck thickness, and adding the theoretical immediate and long-term dead load deflection for the deck and diaphragms. In the field the contractor determines each haunch thickness by subtracting the surveyed top of beam elevation from the beam line haunch elevation on the plan sheet.

The "Haunch Data Detail" sheet includes the following:

- "Table of Beam Line Haunch Elevations";
- "Miscellaneous Data Table" for immediate and long term deflections of the slab and diaphragms, cross slope adjustments, and allowable field haunch;
- "Haunch Locations"; and
- "Haunch Detail".

A blank sample sheet is shown in the methods memo in the commentary for this article ~~[OBS MM No. 62]~~.

In relatively complex PPCB bridges, the designer may need to provide the slab thickness at beams for all beam lines. The designer shall discuss the presentation of the information with the supervising Section Leader.

If a permissible closure pour is shown on the concrete placement diagram, the designer shall note that beam line haunch elevations need to be modified to accommodate the closure pour.

5.3.3 CWPG bridges

5.3.3.1 Analysis and design

Because camber can be cut into the web of a continuous welded plate girder (CWPG), the haunch can be relatively constant.

As with other beam or girder superstructure types the designer should stay at least 0.5 inch within the maximum haunch of 3.5 inches at centerline of girder and -0.5 inch at edge of girder. These limits will be given for the contractor in a note on the plans.

The maximum and minimum haunch limits may, however, be controlled by shear stud heights. The minimum shear stud clearance from top of deck is 2.5 inches, which may control minimum haunch, and the minimum shear stud embedment into the deck is 2.0 inches, which may control maximum haunch.

To start, set the minimum haunch at 0.5 inch at centerline of girder but not less than 0.0 inch at edge of the top flange after cross slope is considered. During construction the contractor then will have 0.5 inch tolerance for minimum haunch.

Once the minimum is set, the haunch thickness can be checked along the entire girder line. Changes in thickness of the top flange will affect shear studs, and therefore the changes need to be considered as well as shown on the haunch thickness diagram on the plans.

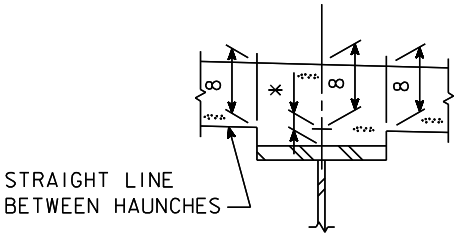
Check the minimum and maximum haunches based on shear stud heights. The maximum haunch should not exceed 3.0 inches so that the contractor has 0.5 inch tolerance for maximum haunch in the field. Modify the bridge seat elevations, girder camber, and shear stud heights as necessary to fit within the

haunch limits. If the haunch limits appear not to work for the project, the designer shall consult with the supervising Section Leader.

5.3.3.2 Detailing

For typical CWPG bridges the designer should provide the following information and haunch details for interior girders on the plans. (See the example drawing in the commentary.) ~~[OBS MM No. 115]:~~

- "Dead Load Deflection Diagram",
- "Girders as Fabricated Horizontally", and
- "Theoretical Concrete Haunch Diagram".



TYP. SLAB & HAUNCH DETAIL

* CONCRETE HAUNCH DIMENSION MEASURED BETWEEN BOTTOM OF SLAB AND TOP OF TOP FLANGE PLATE AS SHOWN ON THE "THEORETICAL CONCRETE HAUNCH DIAGRAM" SHOWN ELSEWHERE ON THESE PLANS.

THE MAXIMUM EMBEDMENT OF THE EDGE OF THE TOP FLANGE INTO THE SLAB SHALL BE $\frac{1}{2}$ INCH. SHEAR STUDS ARE TO HAVE A MINIMUM PENETRATION OF 2 INCHES INTO THE SLAB AND BE AT LEAST $2\frac{1}{2}$ INCHES CLEAR OF THE TOP OF THE SLAB. THESE REQUIREMENTS WERE USED IN SETTING THE MAXIMUM AND MINIMUM ALLOWABLE FIELD HAUNCH VALUES SHOWN IN THE "MISCELLANEOUS DATA TABLE" SHOWN ELSEWHERE ON THESE PLANS.

Figure 5.3.3.2. Typical slab and haunch detail

In addition, the designer shall provide a plan sheet titled "Haunch Data Detail" with the following ~~[OBS MM No. 62]~~:

- "Table of Beam Line Haunch Elevations",
- "Miscellaneous Data Table",
- "Haunch Locations", and
- "Haunch Detail".

In relatively complex CWPG bridges, the designer may need to provide the deflection, girder fabrication, and theoretical haunch information in special tables and details. The designer shall discuss presentation of the information with the supervising Section Leader.

5.3.4 RSB bridges

5.3.4.1 Analysis and design

For a three-span rolled beam standard bridge the designer shall determine rolled beam haunch with respect to the dead load deflections given on the appropriate standard plan sheet [OBS RS40-BD1-04 to RS40-BD8-04].

As with other beam or girder superstructure types the designer should stay at least 0.5 inch within the maximum haunch of 3.5 inches at centerline of beam and -0.5 inch at edge of beam. These limits will be given for the contractor in a note on the plans.

The maximum and minimum haunch limits may, however, be controlled by shear stud heights. The minimum shear stud clearance from top of deck is 2.5 inches, which may control minimum haunch, and the minimum shear stud embedment into the deck is 2.0 inches, which may control maximum haunch.

To start, set the minimum haunch at 0.5 inch at centerline of beam but not less than 0.0 inch at edge of the top flange after cross slope is considered. During construction the contractor then will have 0.5 inch tolerance for minimum haunch.

Once the minimum is set, the haunch thickness can be checked along the entire beam line. Changes in beam depth will affect shear studs, and therefore the changes need to be considered as well as shown on the haunch thickness diagram on the plans.

Check the minimum and maximum haunches based on shear stud heights. The maximum haunch should not exceed 3.0 inches so that the contractor has 0.5 inch tolerance for maximum haunch in the field. Modify the bridge seat elevations and shear stud heights as necessary to fit within the haunch limits.

If these modifications do not position the haunch within limits, consider camber but generally camber a beam only if the maximum haunch is greater than 2 inches. Rolled beams can be cambered at the mill by cold cambering or at the fabrication shop by cold or heat cambering in accordance with the standard specifications [IDOT SS 2408.16].

If the haunch limits appear not to work for the project, the designer shall consult with the supervising Section Leader.

5.3.4.2 Detailing

For a three-span rolled beam standard bridge the designer should provide the following camber and haunch information on the plans [OBS SS 5252-5259, modifications in process]:

- “Beam Camber” and
- “Theoretical Haunch Diagram”.

The “Dead Load Deflection Diagram” is provided as a standard sheet [OBS RS40-BD1-04 to RS40-BD8-04].

In addition, the designer shall provide a plan sheet titled “Beam Line Haunch Data” [OBS SS 5261A, 5263A, etc.]. The sheet shall include the following [OBS SS 5261A, 5263A, etc.]:

- “Table of Beam Line Haunch Elevations”,
- “Miscellaneous Data Table”, and
- “Haunch Detail”.

Haunch locations are shown on the “Slab Elevations Sheet” and need not be redrawn on the “Beam Line Haunch Data Sheet”.

For an example of haunch and shear stud presentation for a three-span rolled beam standard bridge the designer may consult the plans for Woodbury 104.